



# AgConnections

AGRICULTURAL SAFETY AND HEALTH

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NIOSH Agricultural Research Centers Update

## The National Institute for Environmental Health Sciences (NIEHS) Agricultural Research Projects

Human health and human disease result from three interactive elements: environmental factors, individual susceptibility, and age. The mission of the (NIEHS) is to reduce human illness and dysfunction from environmental causes by understanding how each of these elements interrelate. The NIEHS achieves its mission through multidisciplinary biomedical research programs, prevention and intervention efforts, and communication strategies that encompass training, education, technology transfer, and community outreach. NIEHS puts special emphasis on agricultural exposures. Agricultural chemicals have increased food production to meet the needs of rising populations here and abroad, but can pose serious health risks at high exposures. Several projects examine agricultural chemicals and minority health issues.

## Agricultural Health Study

The NIEHS, in partnership with the National Cancer Institute (NCI), has a long-term study of farmers and pesticide applicators, and their families, to determine the health consequences of exposures typical in rural environments. A large part of this cohort includes African-American families. The focus of the NIEHS study component is on non-cancer endpoints.

*continued on page 3*

## Organic Dust and Respiratory Disease in Agriculture

Respiratory complaints are common among farmers. In an occupational health clinic run for members of the central New York farm community, we find that respiratory problems consistently exceed other occupational diagnoses. Among these problems, asthma/hyper-reactive airways has been the most common problem in each of the past five years. Chronic bronchitis is the next most common problem in this predominantly non-smoking population of farmers. Occasional cases of hypersensitivity pneumonitis ("farmers' lung") are seen each year. Problems relating to oxides of nitrogen (silo gas) are rarely seen in our clinic.

Our experience with this largely dairy farm population is hardly surprising in light of the literature on respiratory disease in agriculture. The farm environment provides myriad exposures that can adversely affect the human lung. These include both organic and inorganic dusts, toxic gases, pesticides and other chemicals and zoonoses. As is often the case in agriculture, the intensity of exposures here can substantially exceed those encountered in most other work environments.

This is certainly the case for organic dust, which can be generated in extremely high levels with certain work processes. Previous work on New York dairy farms done by Northeast Center for Agricultural Health (NEC) researchers documented levels of respirable dust and endotoxin during the course

of upright silo opening that far exceeded recommended limits. Unprotected workers in this environment inhale substantial levels of endotoxin and other biologically active substances. It is in this setting that workers develop Organic Toxic Dust Syndrome (ODTS), a

flu-like illness with onset four to six hours after the exposure. Similar reactions have been described in composting operations, swine confinement and other settings involving high levels of aerosolized microbial organisms.

Organic dust can also cause hypersensitivity pneumonitis ("farmers' lung"), asthma and chronic bronchi-

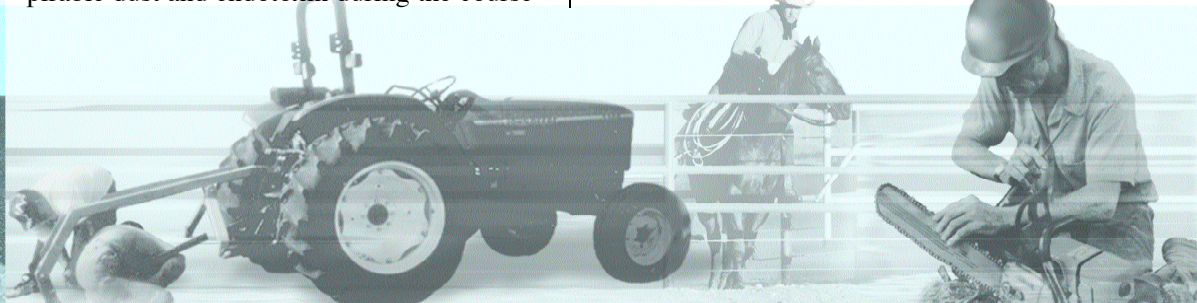
tis. The combination of chronic cough, sputum production and airways hyperreactivity is a common theme among farmers from a wide variety of commodities, though those associated with animal husbandry appear to be at highest risk. Among 1,600 New York farmers surveyed for respiratory problems, we found that 18% reported wheeze – often occurring in the setting of barn dust, pollen and animal exposures. Notably, only 14% of these farmers were smokers, a rate considerably below that of the general population.

Clearly many of these problems can be prevented. Work at our center has included efforts to reduce the generation of dust in barns and efforts to enhance the use of appropriate respiratory protection. In a previous

*continued on page 3*



John May, M.D.  
Northeast Center Director





## UI Study Finds Increased Asthma Among Iowa Children Living on Hog Farms

*Great Plains Center*

New research has found the prevalence of asthma is elevated among children living on farms where swine are raised. In addition, children living on swine farms where antibiotics are added to feed have an even higher prevalence of the common respiratory disease, according to the UI study.

Researchers examined 644 children age birth through 17 living in Keokuk County, Iowa, to determine links between farm and other environmental risk factors and asthma. In addition to identifying the risk of living on farms that raise swine and add antibiotics to feed, several “early life events,” including premature birth, a respiratory infection under the age of three, and

high risk birth were also associated with asthma.

“Asthma is a multifactorial disease involving the complex interaction of genetic and environmental determinants,” said James Merchant, Dean of the College of Public Health and Principal Investigator for the Great Plains Center for Agricultural Health Keokuk County Rural Health Study. “This tends to make epidemiologic investigations of farm-related asthma very difficult. The results of this study are all the more meaningful because we have taken into account multiple personal and other environmental risk factors.”

The full report may be accessed online at the Environmental Health Perspectives website at <http://ehp.niehs.nih.gov/members/2004/7240/7240.pdf>. A chart showing prevalences of asthma in rural Iowa children, according to their living environments, is available for downloading at <http://www.public-health.uiowa.edu/news/releases/figure1.pdf>

## Organic Dust Exposures: New Evaluation Methods — HI-CAHS Center

Organic dust exposures affect more than 1 million men, women, and children in North America. Epidemiological studies have found significant changes in pulmonary function and increased respiratory symptoms in 20% to 30% of farmers working with grain and in enclosed livestock facilities. Gram-negative bacterial endotoxin plays an important role however, these organic dusts are quite complex and there is a need to develop improved tools for exposure assessment. The High Plains Intermountain Center for Agricultural Health and Safety (HICAHS) and the Great Plains Center for Agricultural Health (GPCAH) are collaborating on a study to evaluate new methods for measuring inhalable particulates, including endotoxins, and glucans/ergosterols that can be used to better understand the causes of disease in these environments. Inhalable samplers including the IOM and Button Sampler are being compared to traditional gravimetric methods under controlled laboratory conditions and in the field. The GPCAH studies (Drs. O’Shaughnessy and Thorne) are being conducted in a “still air” chamber, while the HICAHS studies (Drs. Reynolds, Tessari, Tillery and Keefe) are exploring effects of varying wind velocities in a wind tunnel. The performance of these devices for measuring endotoxins and glucans/ergosterols is also being determined. A key aspect of this work also involves developing correction factors for direct-reading aerosol instruments that can be readily used by practitioners for interventions.

Preliminary studies with standardized inorganic dusts found that the samplers performed as theoretically predicted. However, in initial studies with agricultural dusts their collection characteristics differ from expected as the dust type differs in terms of substance (homogenous grain dust) and complexity (heterogeneous swine dust). An important aspect of this work involved optimization of a new Recombinant Factor C (rFC) endotoxin assay at HICAHS. Different extraction methods, reproducibility, and recovery were evaluated. The rFC assay was compared to the KQCL assay and to C/MS. Tween (0.05%) extraction media

and endpoint analysis provided the best spike recovery and reproducibility for the new rFC assay. Samples from experiments with swine dust have been analyzed for endotoxin using the Recombinant Factor C assay and the KQCL assay.

Consistent correlations in endotoxin content were found among the various sampling devices. ANOVA confirmed differences in potency (EU/mg) content of the size selective sampling devices, and there may be a trend with lower stages of a cascade impactor (cut point  $\leq 2.8$  microns) containing about half the EU/mg of upper stages.

While research with additional agricultural dusts continues, Drs. Reynolds, Burch, Tessari and Keefe are applying the (rFC) endotoxin assay in concert with mass spectrometry to explore the role of endotoxin exposure and genetic factors in lung disease among workers exposed to corn dust. This project involves close collaboration with the University of Utah ERC, Duke University, University of Saskatchewan (Institute of Agricultural, Rural, and Environmental Health), and NIOSH. In addition to characterizing worker exposure, these studies also include evaluation of respiratory outcomes including symptoms, cross shift changes in pulmonary function (PFT) and cellular/immune markers (cytokines), a survey of genetic markers related to lung disease and endotoxin etiology (TLR4 gene mutations and polymorphisms of IL1-RN, and TNF-alpha). The objective is to explore whether endotoxin assay or GC/MS is a better predictor of biomarkers, and whether cellular/immune responses and PFT differ by genetic status.



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### **Northeast Center, continued from page 1**

study undertaken with NIOSH researchers, we found that bedding choppers were a major source of organic dust in the dairy barn environment. The simple act of pouring a quart of water into the cut surface of a bale of hay prior to chopping resulted in a 90% reduction in the dust generated by the chopper.

In recent years the NEC has offered free respiratory screening at a number of farm shows throughout the Northeast. We provide a screening plus a short but intensive teaching session with the farmer and family along with samples of approved dust respirators. Preliminary evaluation data from this health screen / education approach indicates moderate success in convincing farmers to use protection on a regular basis. We teach farmers that the combination of dust suppression, ventilation and appropriate respiratory protection is important in any situation where there is visible dust.

<http://www.nycamh.com>

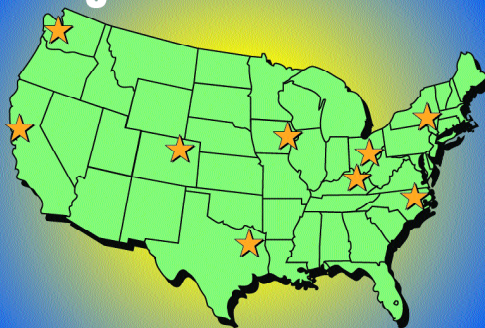
### **Study Examines Farm Residence and Childhood Asthma**

**NCCRAHS**

A retrospective cohort study assessing the role of early farm residence and the development of childhood asthma is underway. "Potential protective factors of early childhood farm residence and the development of asthma," will assess asthma prevalence and potential associations of farm residence, animal (domestic and agricultural) exposure, antibiotic and pesticide exposure, and nonagricultural exposures in the Marshfield Epidemiologic Study Area population. A telephone interview incorporating a modified ISAAC questionnaire and medical record review of all 600 subjects will be conducted among farm and non-farm residents. PI is Steven Kirkhorn, MD, MPH, National Farm Medicine Center Director. Co-PI is Robert Greenlee, PhD, Marshfield Clinic Research Foundation epidemiologist.

<http://research.marshfieldclinic.org/nfmc>

## **Agricultural Centers**



### **Northwest Field Burning Study Completed**

Idaho, Oregon, and Washington dominate the grass seed industry and the latter two states are leading producers of wheat. Until recently, burning was routinely used to eliminate pests and reduce grass and grain residue. Following public outcry and legal challenges over the last 15 years, field burning has been regulated and reduced, but is still pervasive.

The Pacific Northwest Agricultural Safety and Health Center at the University of Washington has completed a feasibility project assessing particulate matter (PM) exposure among wheat farmers during field burning. The results showed acute exposure at levels far higher than the EPA's National Ambient Air Quality Standard and the occupational standards for respiratory dust.

Principal Investigator Dr. L.-J. Sally Liu said, "The results totally took the growers by surprise. Their first reaction was wonderment that they were not dead yet."

The fieldwork for the study involved nine growers and 10 burns in Dayton, Washington. Prof. Chris Simpson's lab at the UW Department of Environmental and Occupational Health Sciences analyzed urinary and filter samples. Results showed that farmers' average exposure to respirable particulate matter (PM<sub>2.5</sub>) during typical field burning ranged between 111 and 7,949 micrograms/cubic meter over 0.6-3.0 hours. (The EPA considers exposure above 65 micrograms/cubic meter within 24 hours to be unhealthy, especially over extended periods.) Farmers with the highest PM<sub>2.5</sub> exposure also showed high levels of biomass burning markers in their urine.

*Project collaborators included Washington State University, the Columbia Conservation District, the Washington Department of Ecology, and the wheatgrowers. For more information contact Dr. Liu at: [SLIU@u.washington.edu](mailto:SLIU@u.washington.edu).*



*Library of Congress*

**NIEHS**  
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### **Pesticide Exposure and Neurologic Function in Farmworkers**

NIEHS-funded researchers will conduct a cross-sectional study of the neurologic effects of chronic, low-level exposure on pesticide exposed farmworkers in central Florida. The largely Hispanic study cohort includes both men and women.

### **Migrant Farmworkers**

California agriculture relies heavily on the use of pesticides and farmworker labor. The State of California requires routine assays of acetylcholinesterase blood levels to monitor potentially adverse effects of pesticides in farmworkers. The NIEHS Center in Davis, California evaluated this monitoring program and discovered that the commercial bioassays being used were inaccurate, often underestimating enzyme levels by as much as 40 percent. The NIEHS Center is now working with state regulatory agencies to develop more accurate testing methods.

### **Minority Farmers Highly Exposed To Agricultural Chemicals**

The NIEHS Environmental Health Science Centers are academic institutions that bring together scientific disciplines to address particular environmental health problems. Three of these centers focus on health concerns of agricultural workers, many of whom are migrant workers or disadvantaged minorities. Results of this research will help define the exposure risks so that better prevention/intervention strategies can be developed to protect their health.

### **Community-Based Prevention/Intervention Research (CBPIR)**

The NIEHS is funding three grants under this initiative related to pesticides.

To learn more about NIEHS programs and funding opportunities, visit the website at:  
<http://www.niehs.nih.gov>



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# LATEST CATCH

## HOT TOPICS

**NIFS Announces 2005 Annual Conference**

NIFS is an organization dedicated to the professional development of agricultural safety and health professionals, providing national and international leadership in preventing agricultural injuries and illness to the agricultural community. NIFS sponsors an annual conference to provide opportunities for sharing information about research and intervention programs, improving professional skills and knowledge, networking and other supportive activities.

The 2005 Annual Conference will be held June 26-30, 2005 in Wintergreen, VA. Visit the website at [www.ag.ohio-state.edu/~agsafety/NIFS](http://www.ag.ohio-state.edu/~agsafety/NIFS) for details.

**NIFS Pre-Conference Workshop**

Timely, evidence-based information on childhood agricultural injury prevention will be featured in a special workshop on June 25, 2005 in conjunction with the NIFS Annual meeting. This special workshop is being co-sponsored by the National Children's Center for Rural and Agricultural Health and Safety and the North American Agromedicine Consortium. For information about the workshop, contact the National Children's Center [nccrahs@mcrcf.mfldclin.edu](mailto:nccrahs@mcrcf.mfldclin.edu), or 800-662-6900 or visit <http://research.marshfieldclinic.org/children> after January.

# LOGGING IN

## VALUABLE RESOURCES

The websites below offer valuable information about agricultural respiratory exposures and protection:

[www.osha.gov/SLTC/respiratoryprotection/index.html](http://www.osha.gov/SLTC/respiratoryprotection/index.html)

[www.osha.gov/SLTC/agriculturaloperations/index.html](http://www.osha.gov/SLTC/agriculturaloperations/index.html)

[www.av.se/english/legislation/afs/eng9411.pdf](http://www.av.se/english/legislation/afs/eng9411.pdf) Organic Dust in Agriculture

<http://www.cdc.gov/niosh/pubs.html> Asthma among Household Youth on Minority Farm Operations

<http://www.cdc.gov/niosh/docs/2005-100/default.html> Respirator Selection Logic 2004

<http://www.cdc.gov/niosh/topics/surveillance/ORDS> Occupational Respiratory Disease Surveillance

<http://www.cdc.gov/niosh/publist.html> Document 94-121 NIOSH Warns of Agricultural Hazards: Organic Dust Syndrome

<http://www.cdc.gov/nasd/search.html>

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